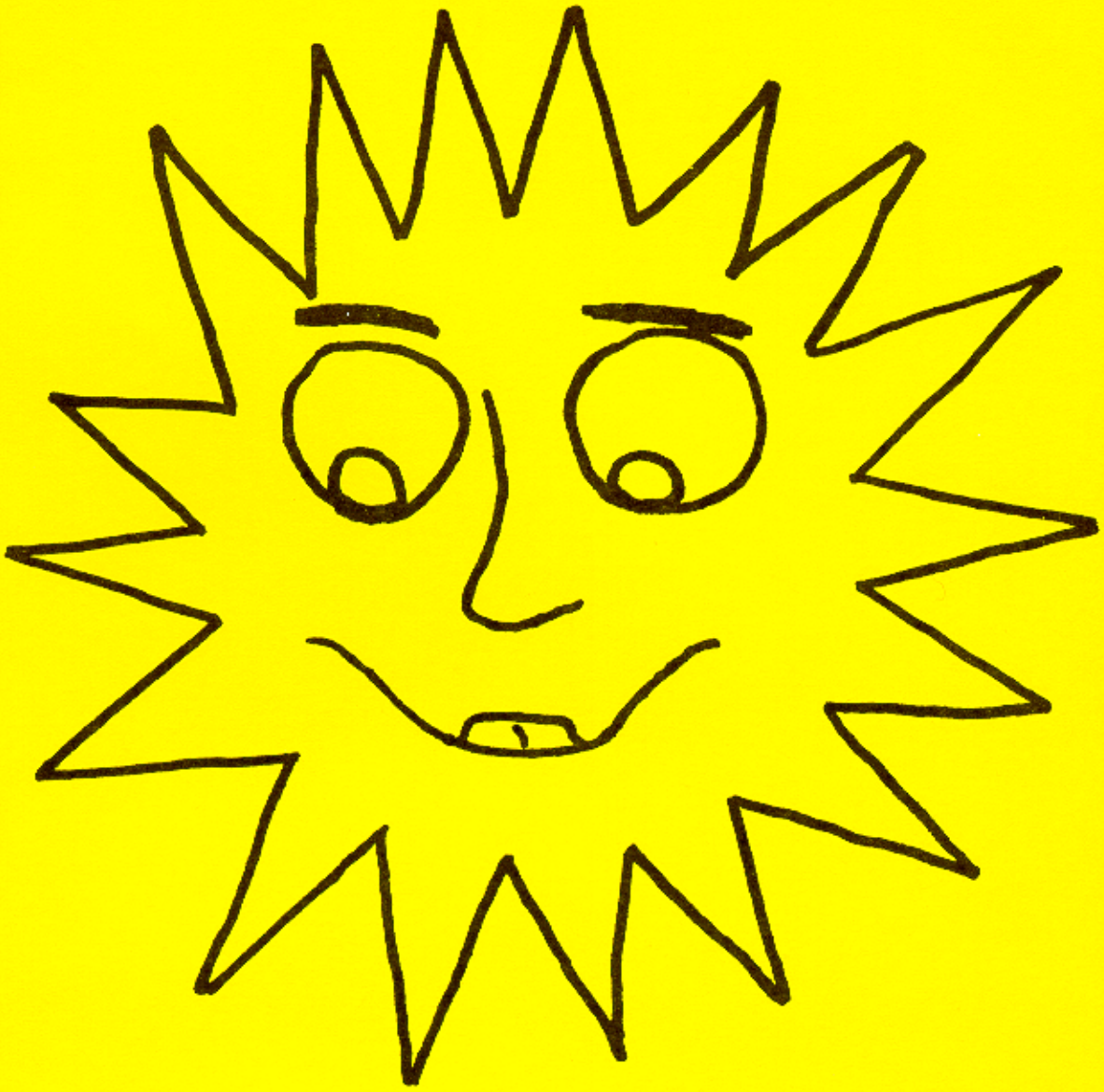
SUN POWER

How sunlight can help supply heat and light for our homes.



by Merle Kindred

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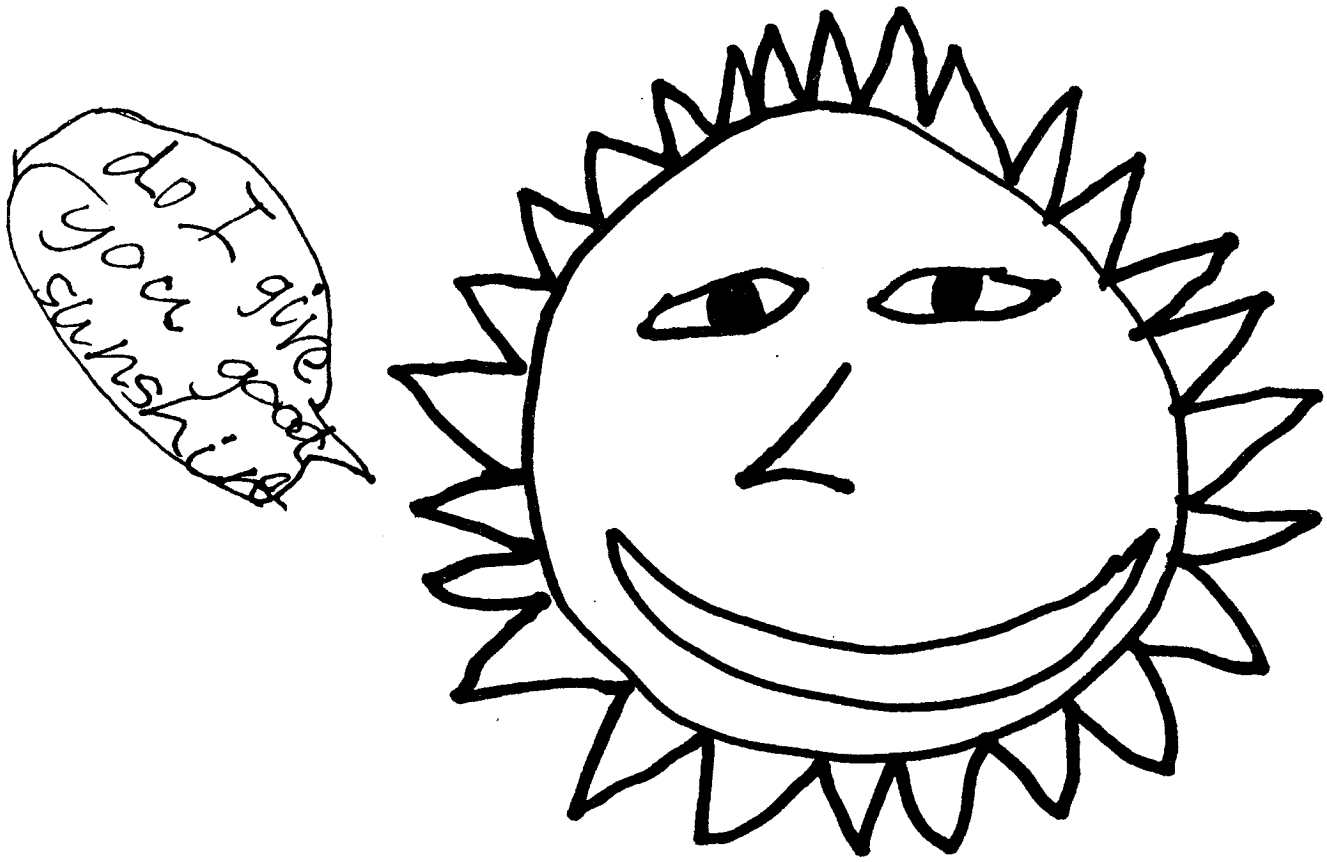

Jake 2B
Korpela

Text: Merle Kindred

Illustrations: Students from Hancock Elementary School

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Also thanks to Mr. Ed Longenecker, Principal of Hancock Elementary School; Mrs. Robin Orr, President of the Parent Teacher Organization; Mrs. Viive Morin, art teacher at Hancock Elementary; and all the students and parents who have so enthusiastically supported this project.

Thanks also to the Community Arts Center in Hancock for displaying in November all the illustrations created for this project to help celebrate October as National Energy Awareness Month.

Thank you to Shawn and Doug Oppliger whose love for the Keweenaw became our love, too. And we thank our grand-daughters (Karen, Ruth, and Louise) whose terrific art work over the years inspired Grandma to use kids' work in these books.

Special thanks to Lola Graves for legal advice and joyous support of this project.

Finally, thank you to Garfield F. (Skip) Kindred, Architect, for his three decades of devotion to passive solar, energy efficient building design. His knowledge is displayed in the Kindreds' new passive solar, super-insulated home in Hancock and in the information distilled into these children's books.

Cover illustration by Lauren Hoffenbecker.

First printing: December, 1998.

(Book recommended for grades 4 - 6.)

There's a song that says that "some of the best things in life are free" and that's certainly true when you think of sunlight. We can always count on the sun to appear every morning and disappear from sight every evening as the Earth whirls around on its axis. And all this sunshine is not only bright and warm, but it's also FREE!

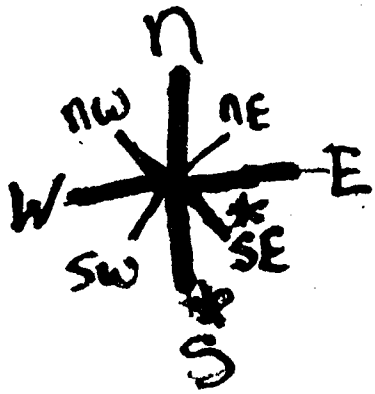
Well, wouldn't it be wonderful to make our homes bright and warm? Sure, but how do we invite the sun inside our homes and get it to stay to help warm us? The answer is to design and build a passive solar, super-insulated house.

Solar comes from the root word **sol**, which means **sun**. **Passive** means something that is quiet - no ugly, big gadgets needed to capture the sunlight for home use. So **passive solar** means the sun is invited to quietly bring light and warmth.

Now look at **super-insulated**. **Super** means something is extra special. **Insulated** means there's extra padding, extra stuffing that does not let heat pass through it. In the case of a passive solar home, there's super-insulation behind the walls and above the ceiling and under the floor that helps keep a home warm in winter and cool in summer.

A **passive solar, super-insulated** house is designed to be energy efficient - to save on using electricity, gas, oil, wood or whatever energy sources are used to help make a house comfortable. Such a house is strongly related to the land, the climate, local building materials, and the sun.

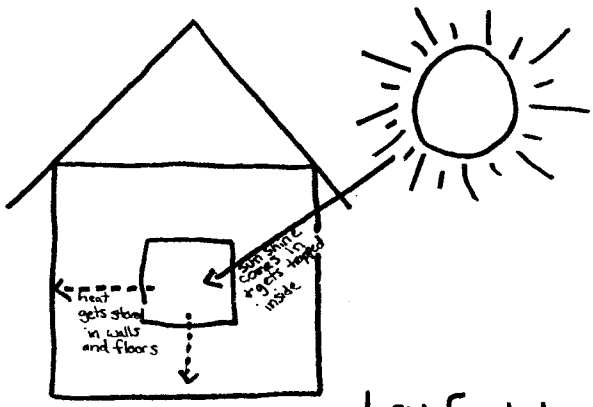
Passive solar heating and cooling systems are simple ideas, are easy to use, have few moving parts, and don't require much attention or money to keep them going, and don't add to pollution.

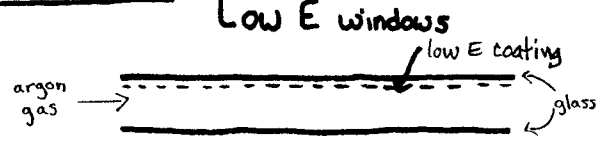


*'s indicates the direction that the sun hits the house best.

Jordan Wolter 6A

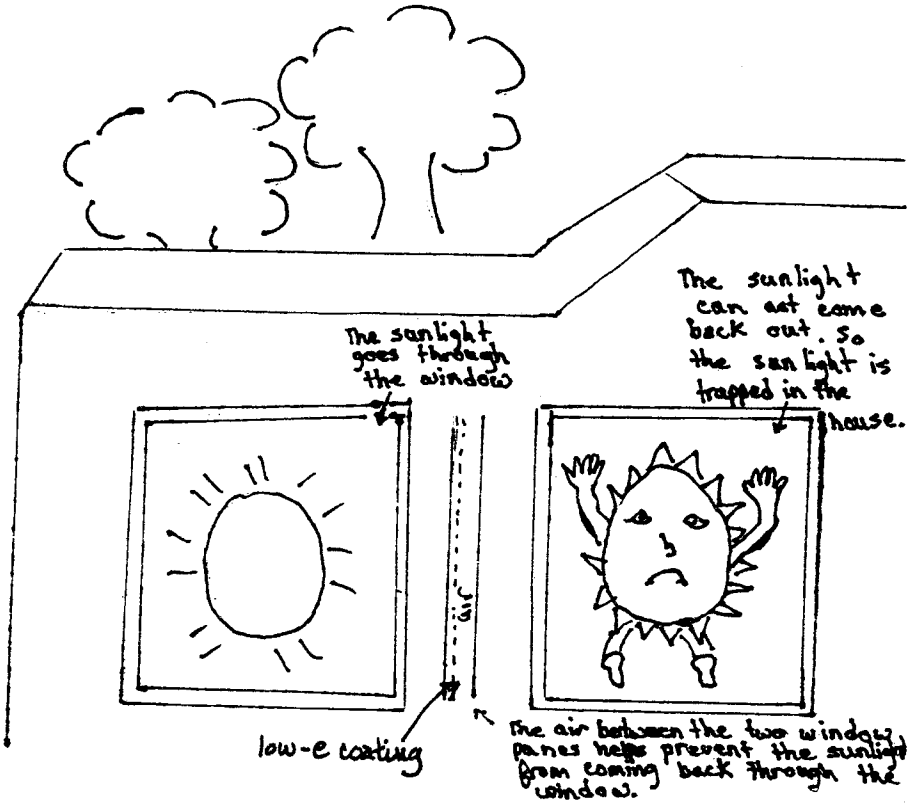
First, there has to be **land**, a lot or acreage that has great sunlight from the south and east. True, sunlight fills the entire sky, but if it is going to be used to provide light and heat for a home, the biggest windows in the house need to face south where the sunlight comes from for most of the day.





Laura Kangas

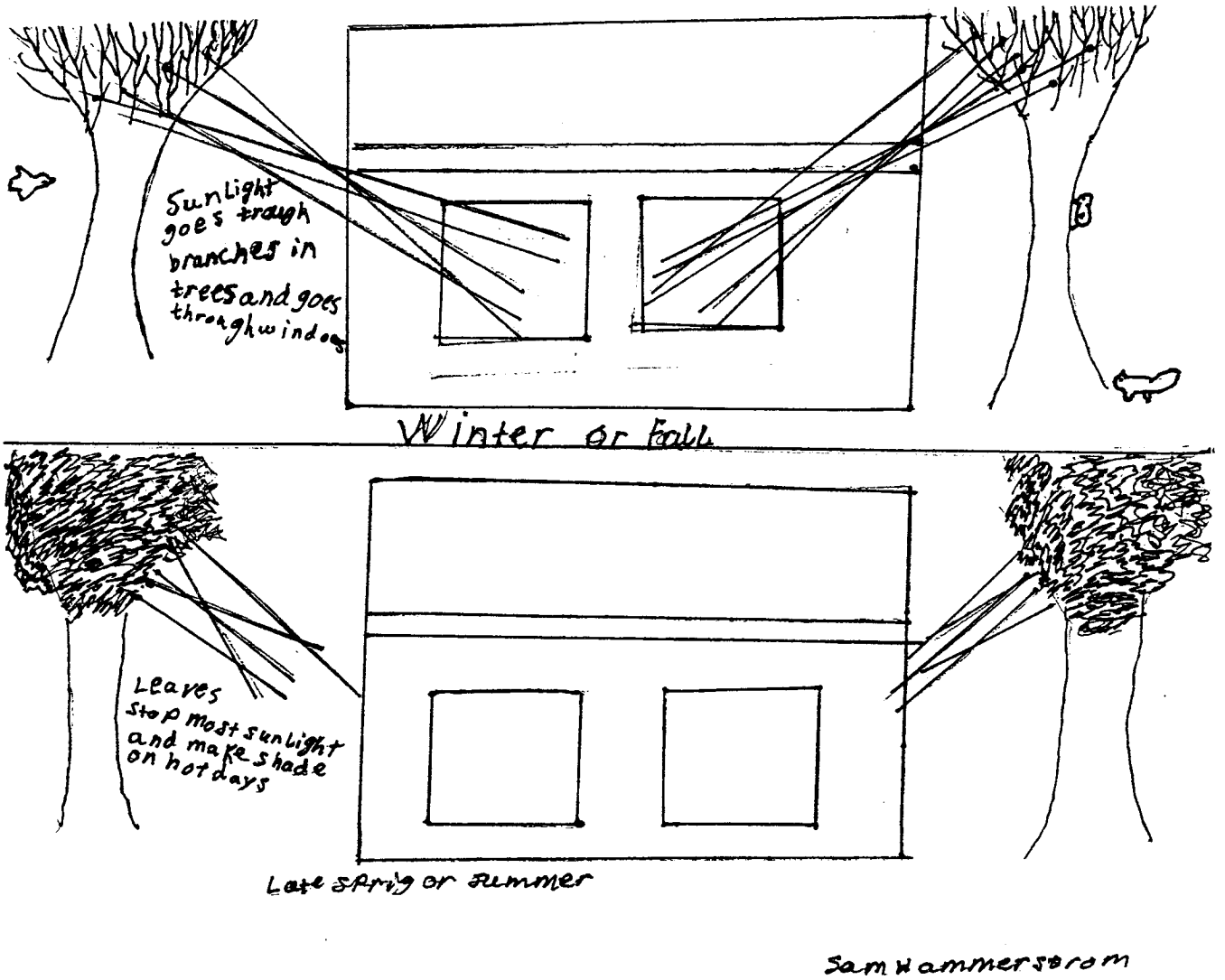
Small **windows** in the house should be on the east, west, and the north side. The east is where we first see the sun in the morning, but it isn't necessarily a strong, warming light. The west is where the sun leaves us in the evening. It is a very strong, bright light -- sometimes just too bright and too hot in the summertime, which would cause the house to overheat. The north side gets little direct sunshine in our Northern Hemisphere, so the windows should be few and small on this side.



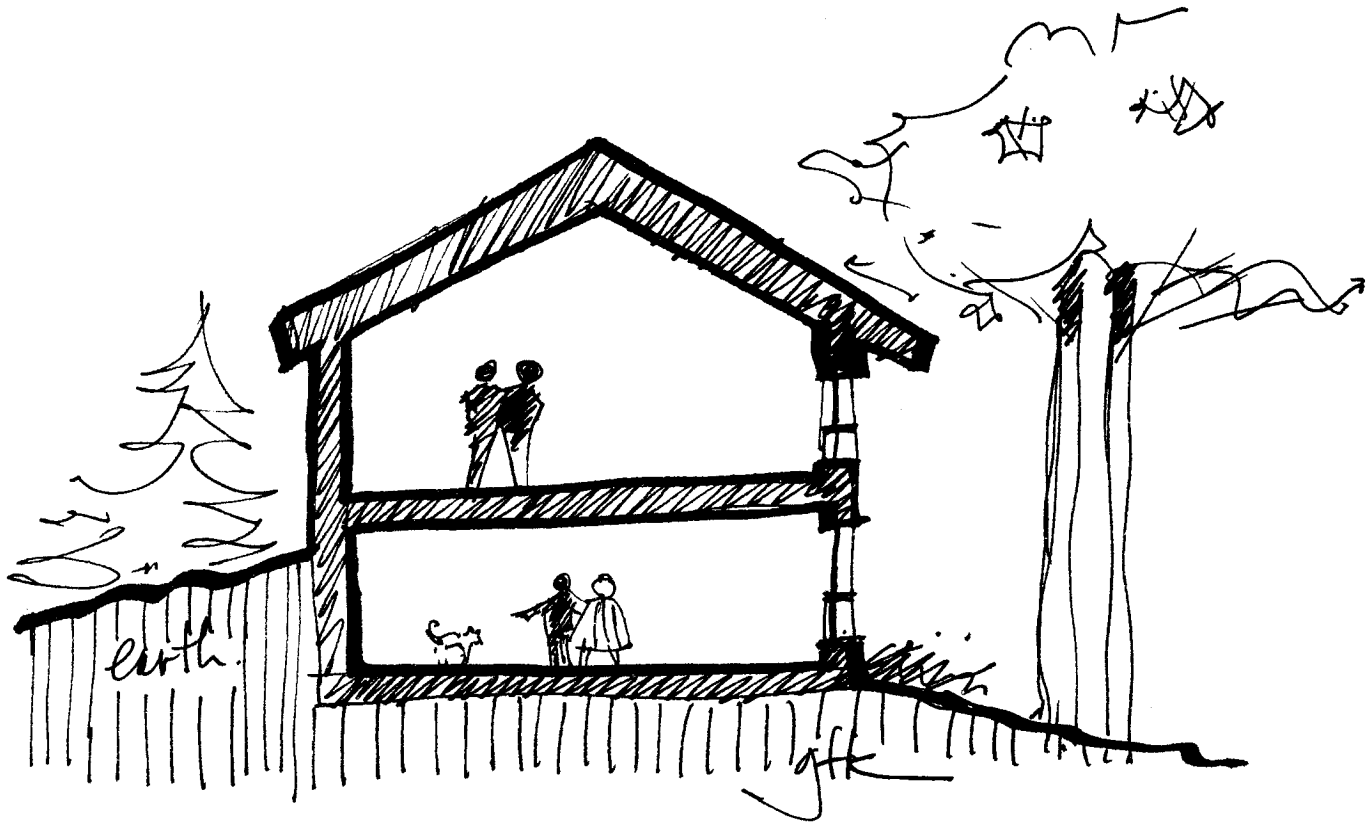
Nicole Yarroch

Have you ever noticed how cold it gets near ordinary windows in cold weather? Well, super-insulated houses also have double-pane windows glass filled with a special gas called **argon** and covered with a special **low-e coating**. These let sunlight into the house where it is converted from light to heat in the ceramic tile, concrete floors, and the inside brick walls. The sunlight is now heat. The low-e coating and the argon gas won't let the heat escape, so our house stays warm. These windows also help protect the home from harmful ultraviolet rays from the sun.

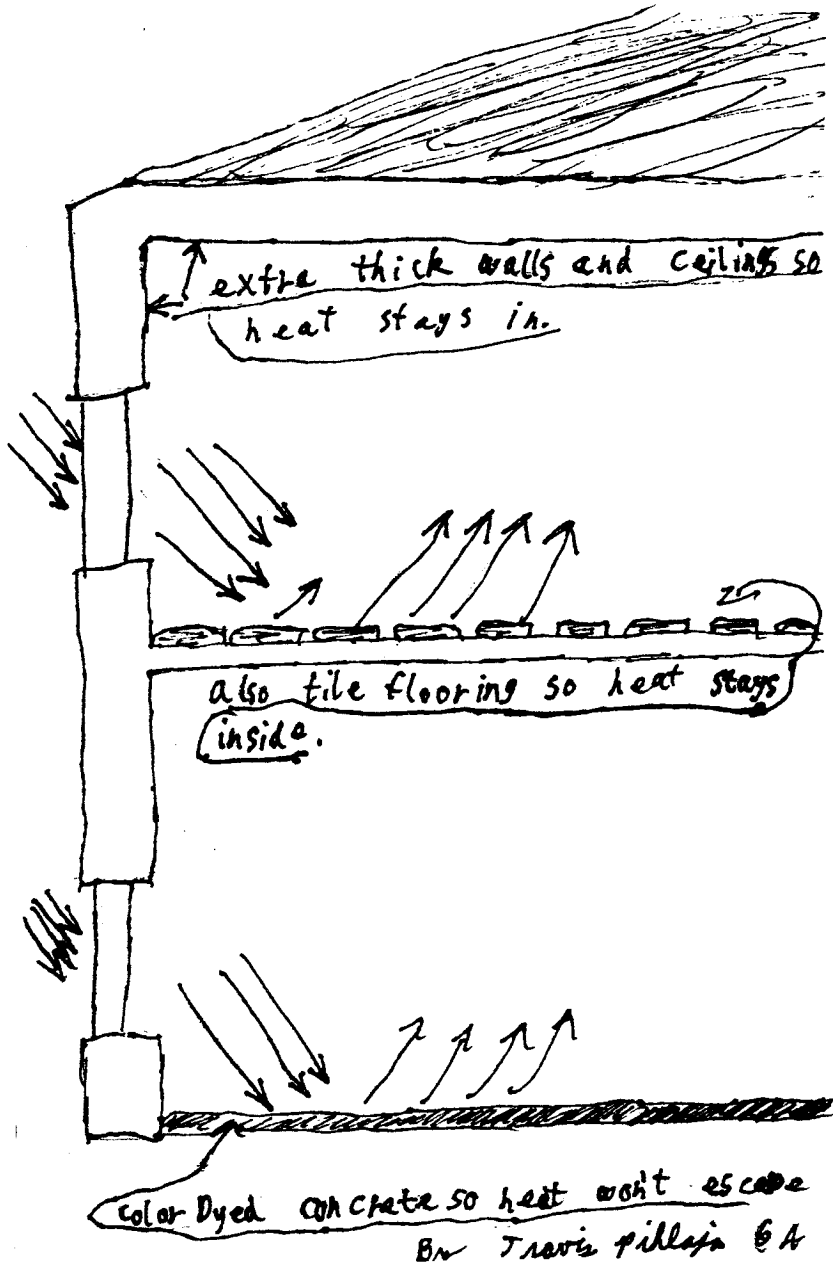
So, the land should have space for a house that can have big south windows for the living room, dining room, kitchen, family room, and maybe some bedrooms. These rooms are where we spend most of our time when we're awake. Work rooms and private rooms like the laundry room and bathrooms, the furnace room and closets, and some more of the bedrooms can be on the east, west, and north sides of the house since we don't spend many of our waking time in them.



TREES that are already growing on the land are very important for a passive solar house. The trees that are really important are called **deciduous**, which means the leaves fall off every autumn and grow back in the spring. Deciduous trees provide natural shading for the house's south windows in the summer and when the leaves fall off in the autumn, the sunlight can reach deep inside the house to warm it in winter. Evergreen or coniferous trees can also be useful because they can help protect the north side of the house from cold winter winds.



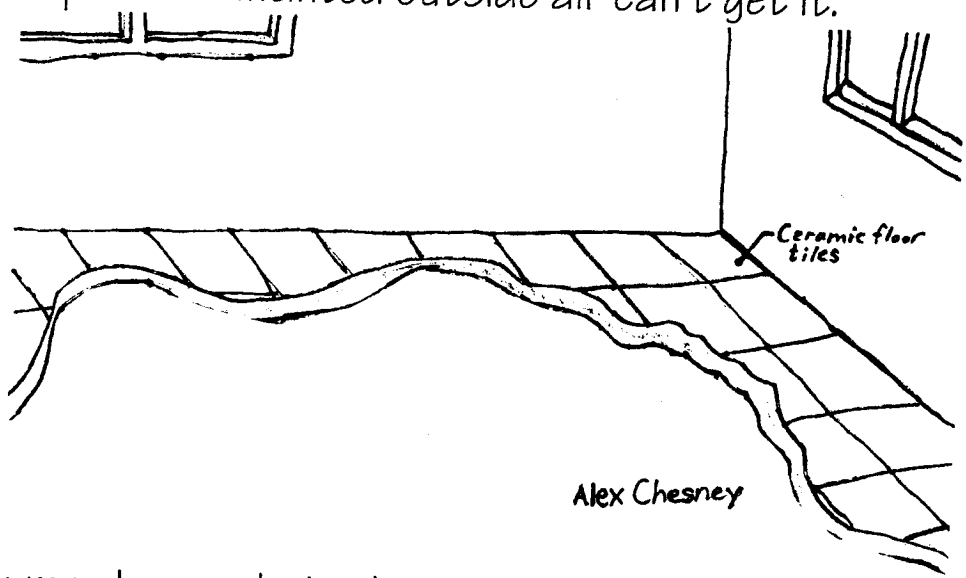
A passive solar, super-insulated house can also make use of land that isn't all flat, that has a slope to it, because the earth can be used to help insulate the house. A wonderful building site is where the house is **earth-sheltered** and can back itself partly into a hillside on the north side and maybe parts of the east and west sides. The earth along part of the first floor walls can help reduce heat loss from the house.



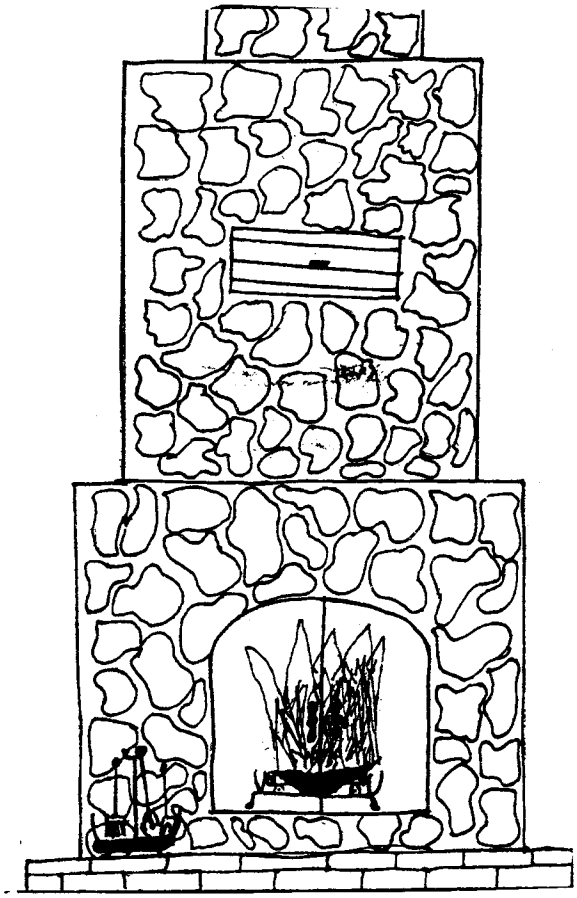
But whether the house fits into a slope or hillside or not, **super-insulation** or extra stuffing is needed when the house is first built. In the winter, this insulation does not let the heat flow through it and therefore helps keep the inside of the house warm. In the summer, the insulation keeps the heat out so the inside of the house stays cool.

Ordinary houses are built with 2-inch by 4- inch studs for the frame, which means the insulation is less than 4 inches thick. Super-insulated houses have 2-inch by 6-inch studs, which means an extra 2 inches of insulation can be added. There's also more insulation over the ceilings and under the floors. The inside walls of the house, made of 2 x 4 studs, can also be made to hold more heat and improve sound proofing (making rooms quieter) by filling the space between the studs with scrap drywall. This also reduces waste materials.

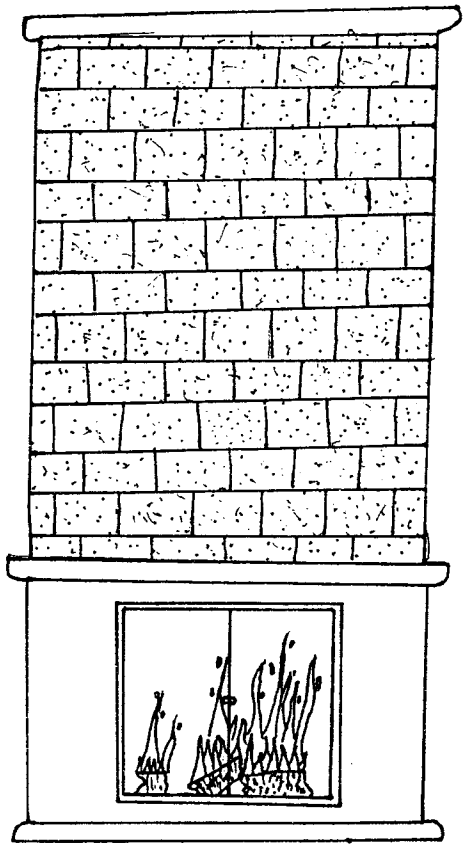
Super-insulated houses are also air-tight, which means there's extra effort used to fill all the tiny cracks between building materials so the house is very snugly built and inside air can't escape and unwanted outside air can't get it.



You may be wondering how all the light streaming into the house and turned into heat is stored at night and during cloudy weather. Well, the floors need to be medium dark **ceramic tile** over a concrete base or **tinted concrete** to hold the heat. There can also be **brick** or **masonry walls** or **fireplaces** to help store the light-to-heat energy. Sorry, no carpeting, vinyl, or wood floors in areas where the sunlight falls. These materials do not store heat as well as materials made of masonry (ceramic tile, stone, brick or concrete block) or concrete.



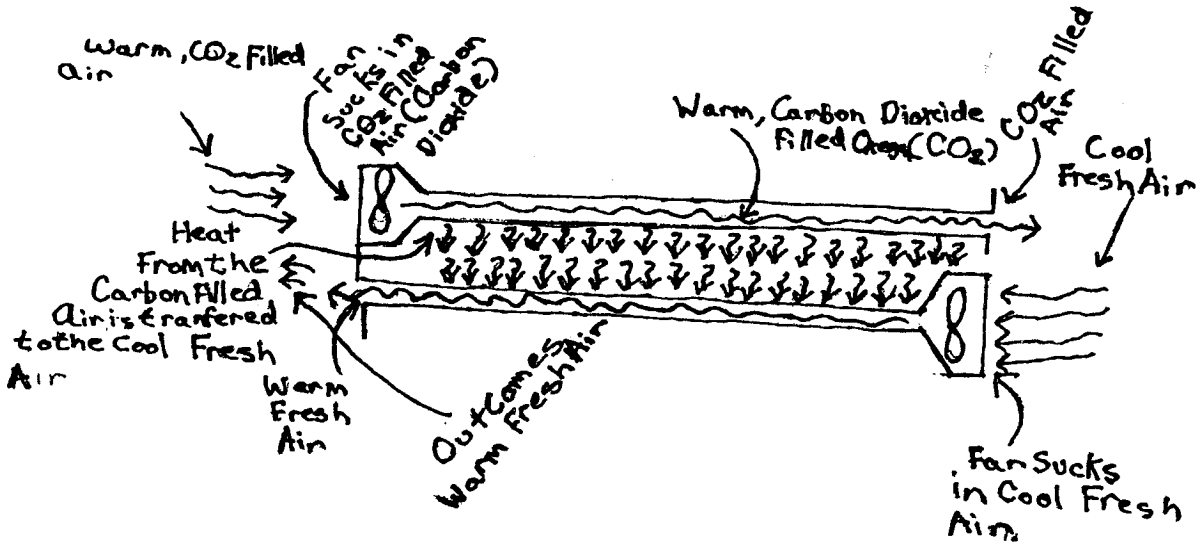
Tom Hicks
6C



Michael Martin

In our passive solar home, we need an **energy efficient fireplace**. This fireplace gets the combustion air it needs to burn from ductwork from the outside of the house. It also has tight-fitting glass doors that allow radiant heat from the fire to warm us, while letting us enjoy looking at the burning logs. The outside of the fireplace can be of brick or stone.

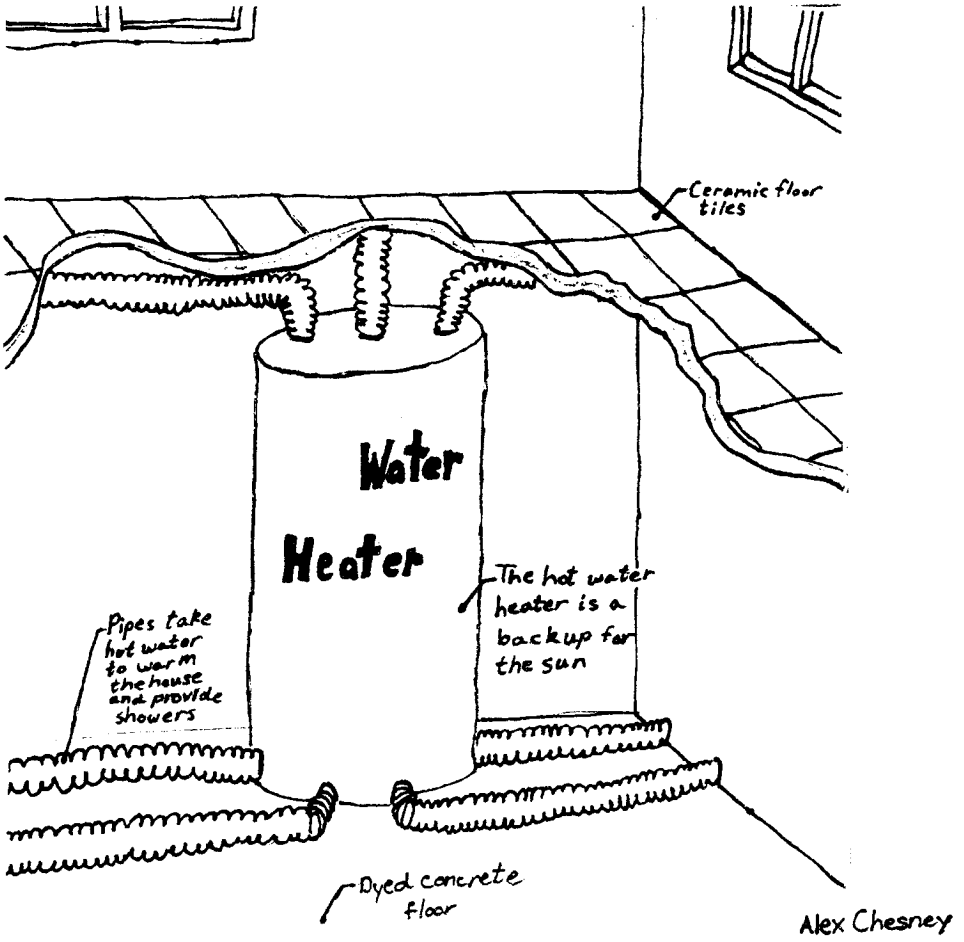
The fire in the fireplace heats the bricks around the fire box. These bricks, in turn, heat the air circulating around them, thus helping heat the house. Vents around the fireplace direct this heat into the house. If the fireplace is placed in the center of a room instead of on an outside wall, heat can come from all sides.



Geof Crowl 6A

Air in houses can get too smelly and humid with all the cooking odors, dirty clothes, moisture from showers, and heat from stoves, computers, TVs., and other equipment. The one big problem with super-insulated houses and is how to get old stale air outside and clean fresh air inside.

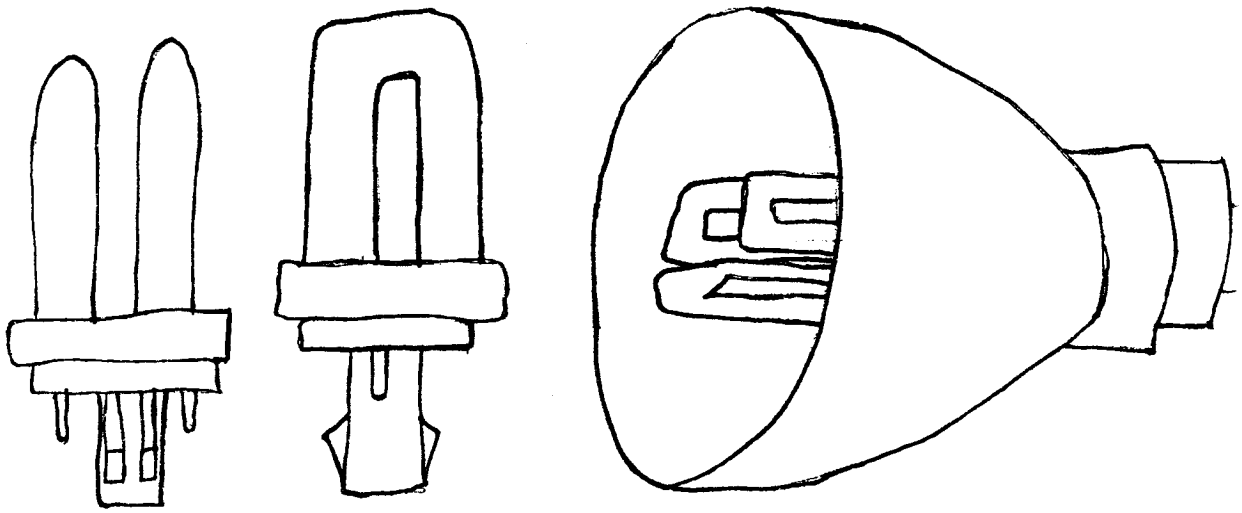
The answer comes by installing a mechanical unit called an **air-to-air heat exchanger**. Pipes called **ductwork** are run behind the walls and above the ceiling. In cold weather, some of this ductwork carries warm, smelly, wet air out of the house. The rest of the ductwork carries cool fresh air from outside into the house. The air-to-air heat exchanger is a box with small fans, air filter units, and a heat exchanger. All the ductwork meets at the heat exchanger where the warm outgoing air helps heat the chilly incoming air. This means in winter our house will still stay nice and warm and dry and have fresh air, too.



We know that every day isn't a sunny day and in some places it can be cloudy for weeks at a time. What happens to our solar home when there's no sun? Well, there needs to be a back-up plan, something that works when the main plan doesn't. A very good, inexpensive way to help keep a solar home warm when there's not enough sunlight is to use the **water heater** as a boiler.

Most homes only use hot water to get everybody started in the morning - maybe showers and a load of laundry. The next time there's need for hot water is in the evening when dinner is being prepared, the dishwasher might be run, and maybe more baths or showers are taken.

Most of the day, the water heater is keeping water hot for no good reason. In an energy efficient home, this water can be run through special pipes in radiators at the baseboards (where walls and floors meet) and help keep the house warm.

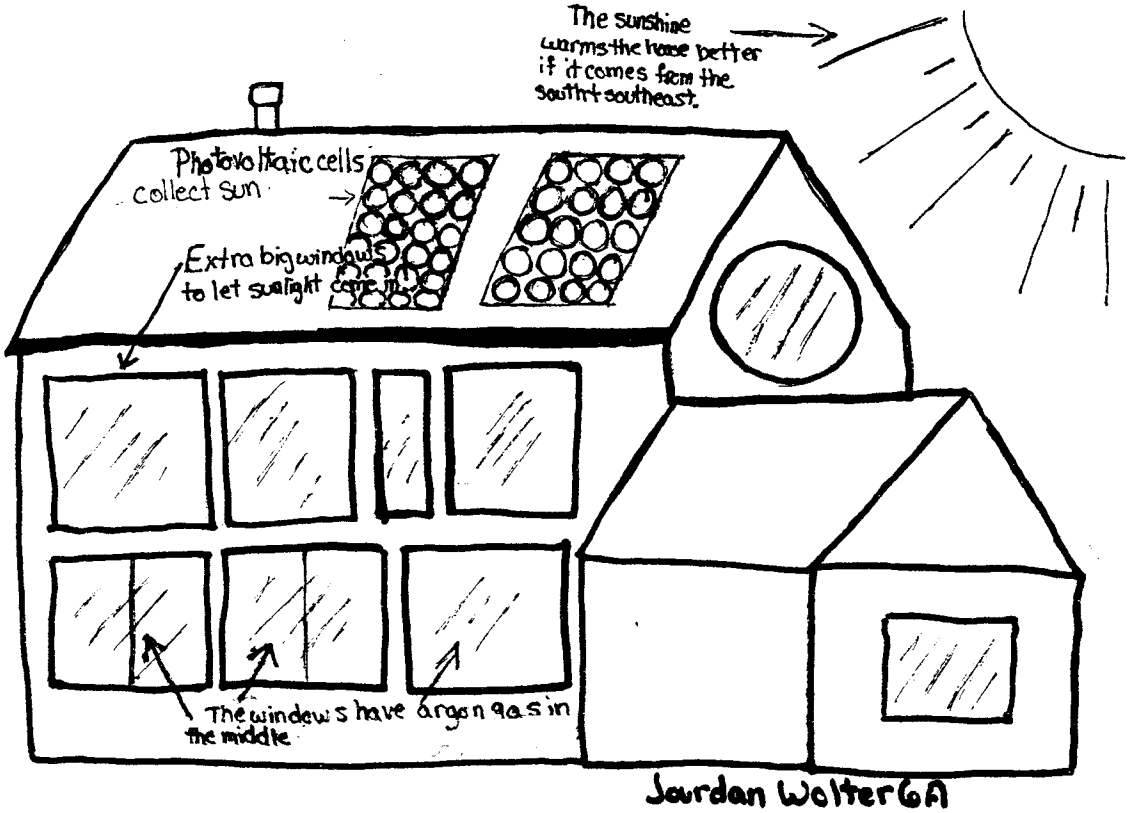


Compact Fluorescent Light bulbs

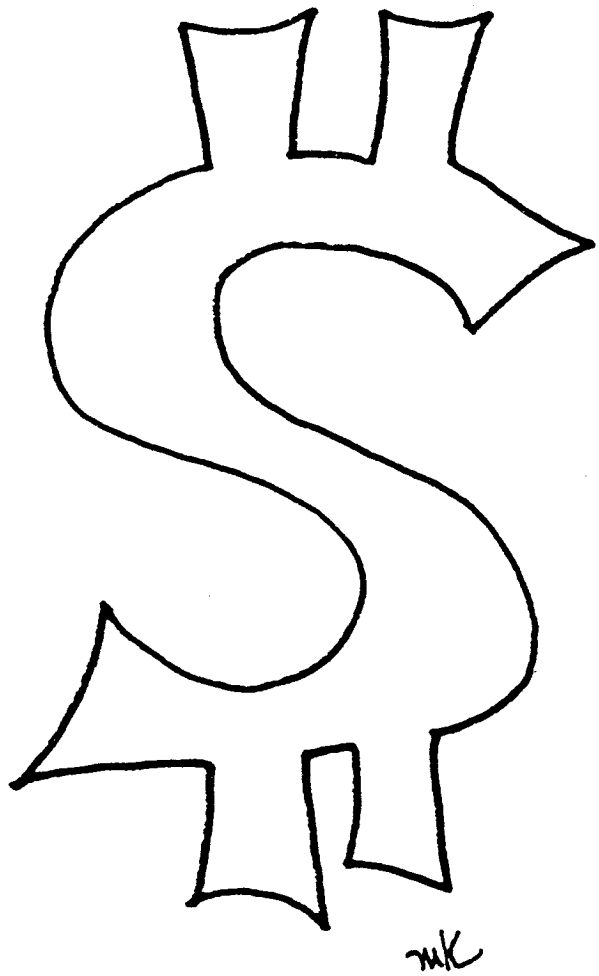
We've talked about how a passive solar, super-insulated house is placed on a piece of land and how the basic house is built, but there are also a number of things that people can do to save energy costs in their home.

Light bulbs can be compact fluorescent fixtures instead of incandescent light bulbs. A 13-watt **compact fluorescent bulb** can produce as much light as a regular 75-watt incandescent bulb, which produces more heat than light anyway.

Bathrooms fixtures that help save water include low-volume toilets and water-conserving shower heads. Appliances - washers and dryers, stoves, refrigerators, dishwashers - all can be chosen by watching for energy saving features, which means they'll use less electricity or natural gas to operate.

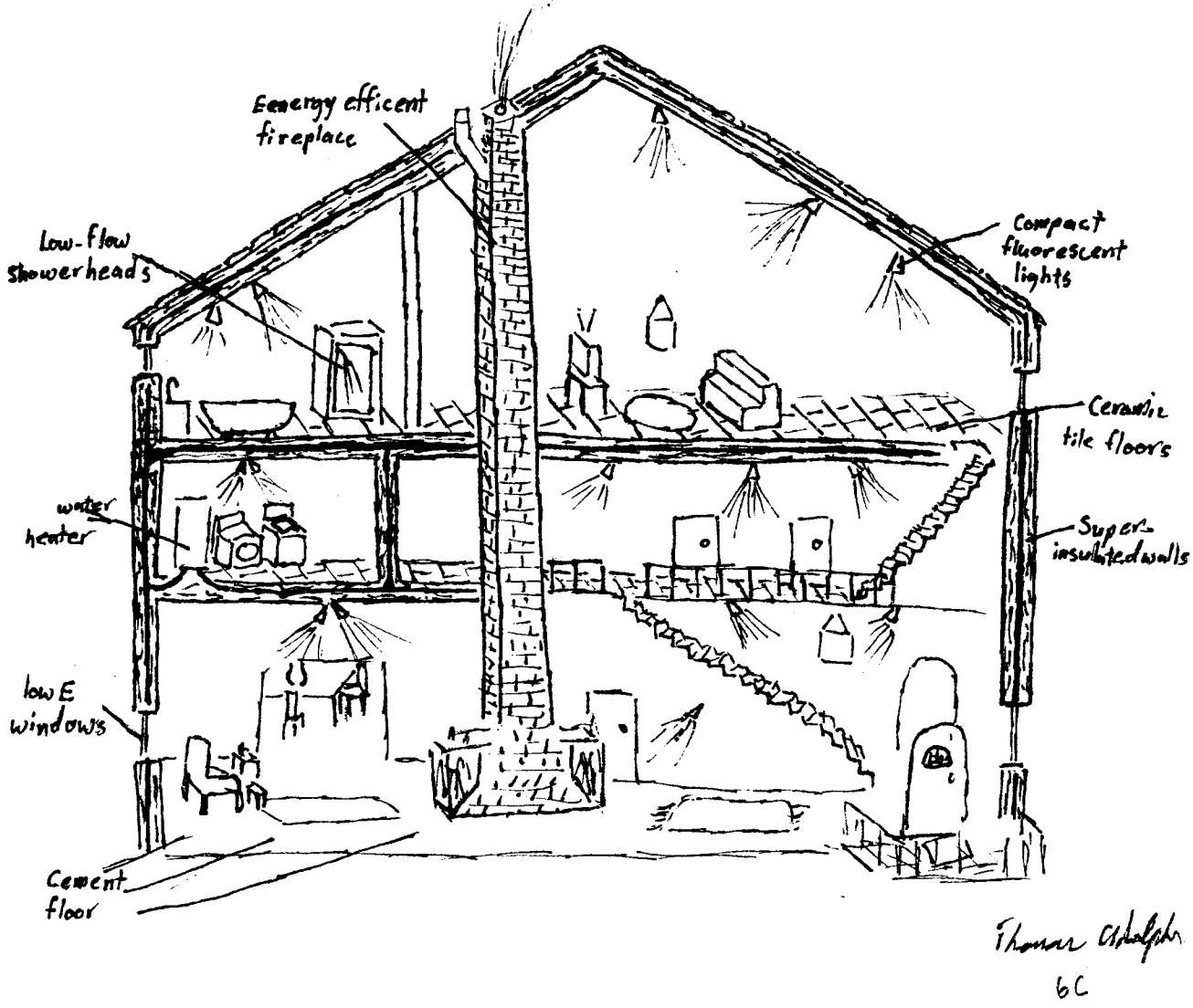


Sometimes the sun can be used to help create electricity for use in the home. **Photo** refers to **light** and **volts** refer to **power; photovoltaics** means **power from light**, in this case -- sunlight. Photovoltaic cells absorb sunlight and convert it directly into electricity. These cells are very thin (1/100th of an inch thick) and are usually made of silicon. The cells are mounted on rooftops or in panels attached to poles facing the sun. When sunlight hits the cells, electrons are released and these flow onto wires forming direct current (DC). A four-inch photovoltaic cell can produce about one watt of DC electricity. This power can also be converted to alternating current (AC), which is used by standard household appliances.



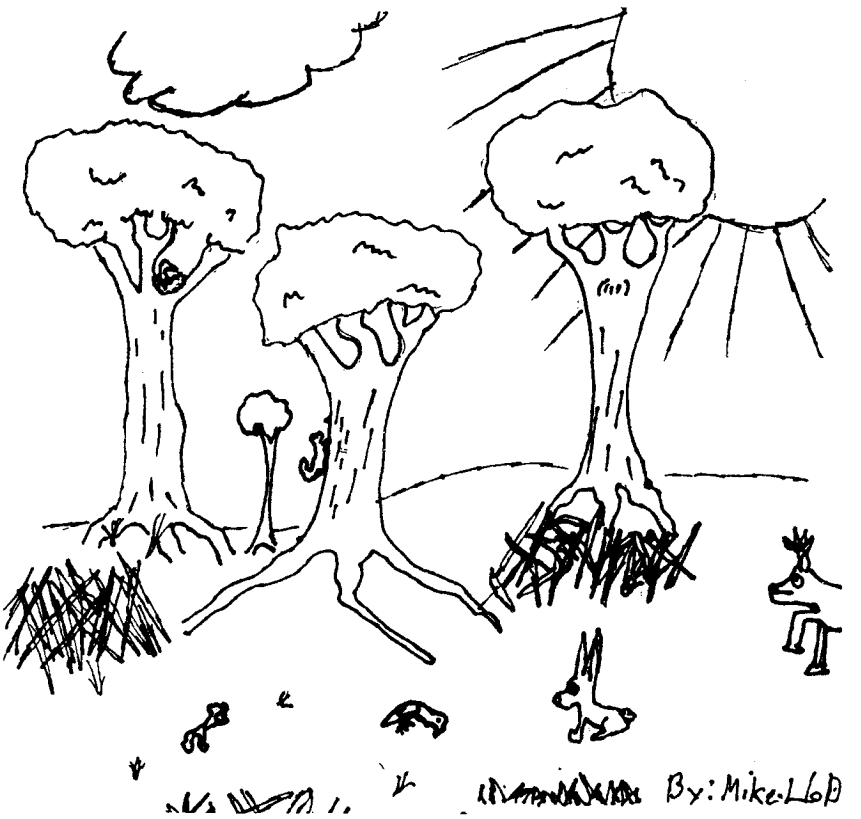
You might be thinking that all these special building materials and ways to build might cost a lot of money and average people won't be able to afford an energy efficient house. It's not true.

A passive solar, super-insulated house only costs about 5 percent more than an ordinary house. That means for every $100 spent to build a regular house, an extra $5 is added to make it energy efficient. So much energy will be saved operating such an energy efficient house, that after five years, a family will have earned back the extra money they spent on building the house through energy savings. After five years, the house will always cost less to operate.



Another way to add to the affordability of the house is to use modular design and construction. **Modular** comes from the word **mode**, which means the way something is usually done. Standard sheets of plywood, drywall, and other kinds of big, flat building material are normally 4-feet by 8-feet. It makes sense to use modular sizes in designing an energy efficient home so you don't waste time and material with odd sizes.

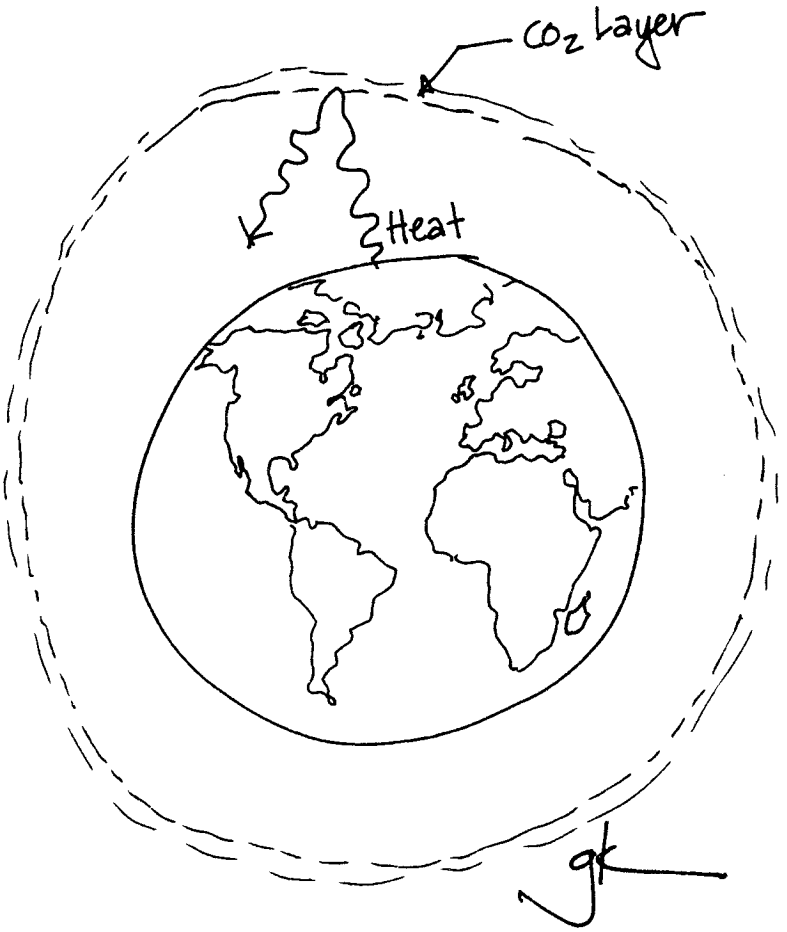
The house can be based on a 4-foot by 4-foot square module (half a sheet of plywood), 2-foot by 4-foot half module (quarter of a sheet of plywood), and 2-foot by 2 foot quarter module (one-eighth of a sheet of plywood). This module design helps make the best use of ordinary building materials and greatly reduces scraps that have to be thrown away.



It makes good sense to build a house that uses free sunshine for light and heat and tries to save as much energy as possible to operate the house. It also makes sense to create an environmentally friendly house on the outside.

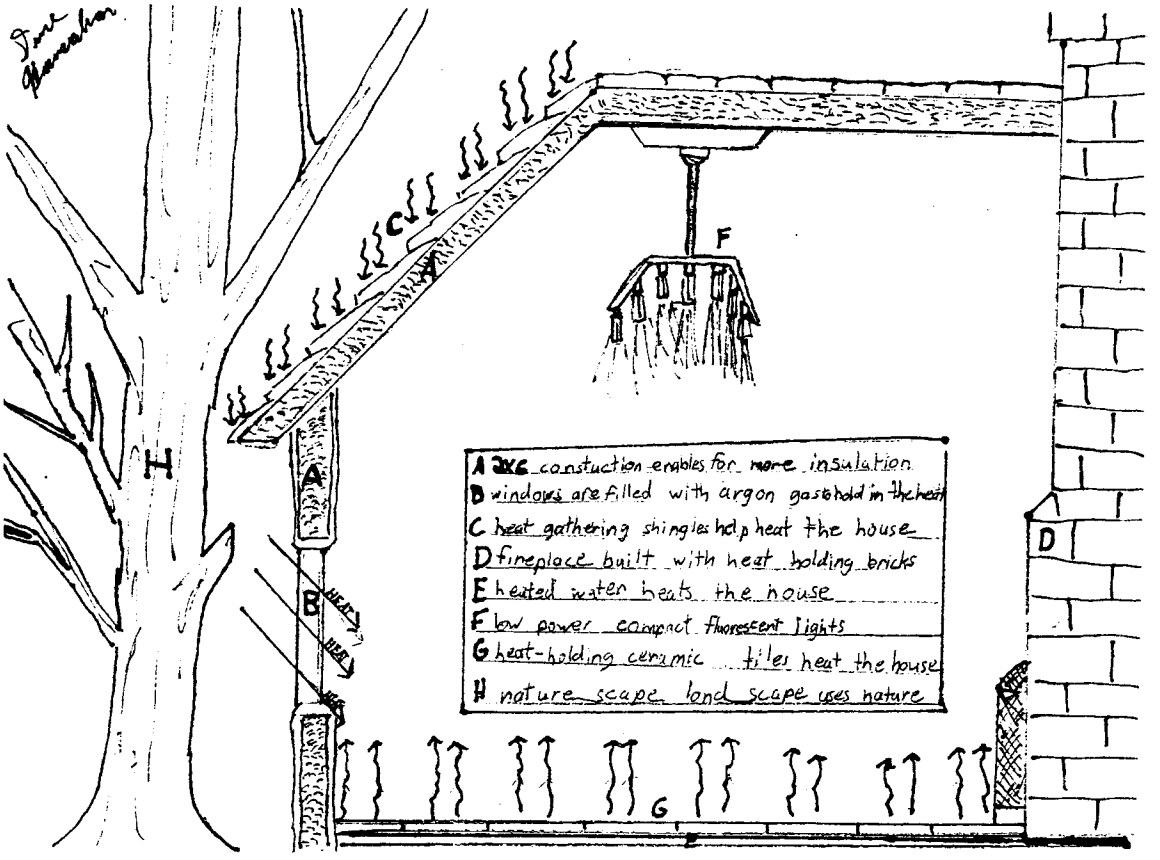
Lawns need to be fertilized (with chemicals or manure) to stay healthy. Lawns often need pesticides sprayed on to keep bugs from destroying them. Lawns also need to be cut regularly to stay healthy and neat. One can avoid these chemicals and work by doing **naturescaping**. This means allowing the natural wild grasses and wildflowers of the area to simply grow where they naturally want to take root. If there are rocks on the property, these can be piled up or spread around to make rock gardens where plants can spread by themselves.

Deadfall, branches and twigs that fall naturally from trees and shrubs, can be piled in quiet areas of the land to provide natural habitats for birds and small animals such as rabbits and chipmunks to find shelter and safety.



By using sunlight to help warm our homes and by saving as much energy as we can, we can help reduce the **Greenhouse Effect**. When we burn gas, oil, and wood to help keep us warm and provide electricity and run our cars, we are creating CO_2 (carbon dioxide) which goes up into the atmosphere. The concentration of CO_2 in the atmosphere is a major contributor to the Greenhouse Effect. The CO_2 acts like insulation and won't let heat escape into outer space as it naturally should. This makes the weather too warm and can harm life on Earth.

The average household produces 23,380 pounds of CO_2 per year. Our Earth-friendly house will produce only half the CO_2 of a regular house. If everybody thought about reducing the amount of energy they used in everyday life through conservation and solar energy and construction strategies already available in the marketplace, we could reduce the amount of CO_2 going out into the atmosphere and help reduce the Greenhouse Effect.



Let's review what we've learned about building a house where we'll "let the sun shine in."

- First, we must have a piece of land where we can design a house with big south windows.

- Next, we need deciduous trees to shade the house in hot weather and then drop their leaves in autumn to allow the winter sun into the house.

- We need a house with extra thick insulation in the walls, above the ceilings, and under the floors.

- We also need special windows that let the sunlight into the house and ceramic tile or concrete on the floors and walls to trap the light as it turns into heat.

- We can have a fireplace, but it must be energy efficient so that it really helps heat the home.

- We also need a mechanical system called an air-to-air heat exchanger which helps chilly, incoming air be warmed by stale, outgoing air.

- We can use our water heater for back-up heat.

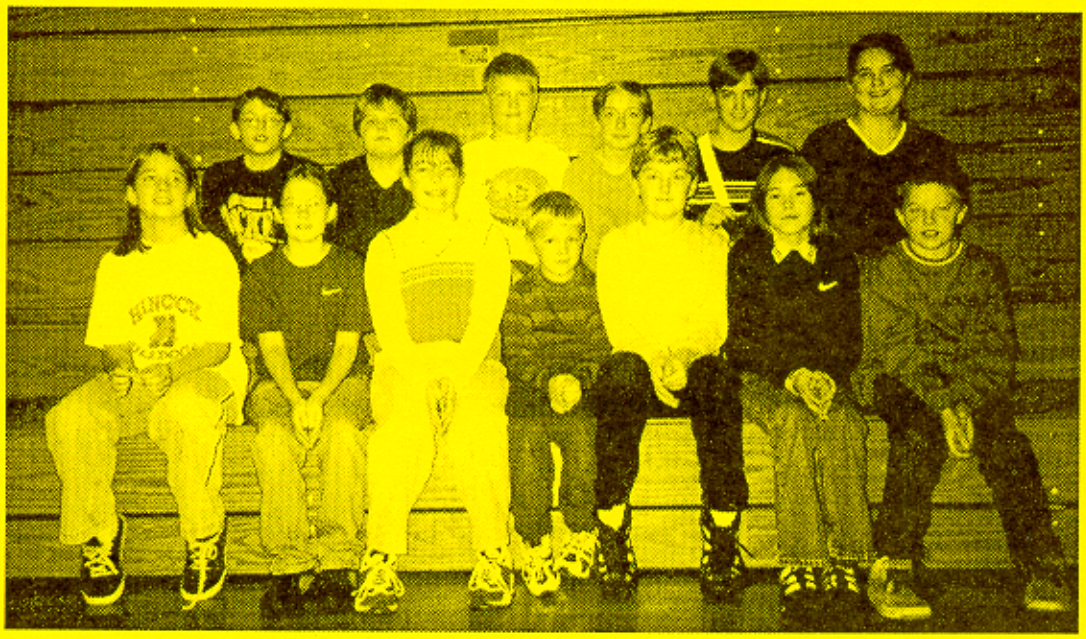
- We can also use energy saving light bulbs and plumbing fixtures that don't use much water.

- We can help the environment by doing naturescaping: encouraging natural growth.

- We can use photovoltaics to make electricity from sunlight.

- Using less energy can reduce the Greenhouse Effect.

So, letting the sun shine in can give us a bright, warm home. It can also help us help the environment.



Illustrators for this book include:

(top row) Tom Hicks, Mike Lypsinmaa, Michael Asiala, Michael Martin, Travis Pihlaja, and Nicole Yarroch.

(bottom row) Alex Chesney, Laura Kangas, Jourdan Wolter, Jake Korpela, Dane Hanrahan, Lauren Hoffenbecker, and Sam Hammerstrom.

(not photographed) Thomas Adolph and Geof Crowl.

When preparing the application for a Five Star Home Grant for energy efficient housing, Merle Kindred included plans for a book for children on passive solar, super-insulated house design. Energy conservation is becoming an increasingly important issue in our lives and will certainly be an even greater concern in the 21st century when today's children become tomorrow's adults. Two books were created: one for K through gr. 3 and another for gr. 4-6.

Merle Kindred is a former VISTA and CUSO Volunteer and has taught in the Virgin Islands, Jamaica, and the Bahamas. She has also served as a high school teacher and college instructor in Michigan and is Business Coordinator of Garfield Kindred Associates, P.C. Architects based in Hancock, MI. She loves writing and has served as a writing instructor with Baker College Corporate Services based in Auburn Hills, MI.

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Additional copies of this book can be ordered for $5 each (including postage and handling):

ckecks payable to: Garfield Kindred Associates
1016 Crestwood Dr.
Hancock, MI 49930-1135
phone: 906/482-7803

(Orders of 10 or more copies, $4 each.)

Also, Sunshine is FREE, written for K - gr. 3, can be obtained for the same price from the same source.

[NOTE: Half the proceeds of the sale of this edition of each book will be donated to the Hancock Elementary School art department.]